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KNOBBE MARTENS OLSON & BEAR LLP
2040 MAIN STREET
FOURTEENTH FLOOR
IRVINE, CA 92614

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BEFORE THE BOARD OF PATENT APPEALS
AND INTERFERENCES

Ex parte ALBERT WANG

Appeal 2008-4454
Application 10/624,728
Technology Center 1700

Decided: September 30, 2008

Before BRADLEY R. GARRIS, LINDA M. GAUDETTE and
JEFFREY B. ROBERTSON, *Administrative Patent Judges*.

ROBERTSON, *Administrative Patent Judge*.

DECISION ON APPEAL

STATEMENT OF THE CASE

Appellant appeals under 35 U.S.C. § 134(a) (2002) from the Examiner's rejection of claims 12 and 18-25.[1] (Examiner's Answer entered

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[1] Claims 1-11 and 13-17 have been cancelled. (Appeal Brief filed August 22, 2007, hereinafter "Br.," 2).

November 29, 2007, hereinafter "Ans."). We have jurisdiction pursuant to 35 U.S.C. § 6(b) (2002).

We AFFIRM.

THE INVENTION

Appellant's claimed invention is directed to a dual chamber processing system that continuously processes a plurality of workpieces including a common power source, a first plasma applicator, a second plasma applicator, a robot, exactly one pump, and a computer. (Spec. [0010]). The computer is configured to control the pump and robot to affect pump-down and subsequent process pumping of one of the chambers during simultaneous venting, workpiece removal and workpiece reloading of the other chamber. *Id.* The pump-down pumping of one of the chambers and the venting of the other chamber begin at substantially the same time. (Spec. [0017], [0018], [0026], and [0027]). The computer is also configured to open the pump to fluid communication with only one of the chambers at a time. (Spec. [0010]).

Claim 12, reproduced below, is representative of the subject matter on appeal.

> 12. A dual chamber processing system for continuously processing a plurality of workpieces comprising:
>
> a common power source switchable between a first plasma applicator of a first chamber and a second plasma applicator of a second chamber,
>
> the first chamber for processing a second workpiece in a vacuum to completion therein when the power source is applied thereto and switched ON,
>
> a robot configured to remove at substantially atmospheric pressure a first workpiece from the second chamber after

processing the first workpiece, the robot configured to reload the second chamber with a third workpiece to be processed while the second workpiece is being processed in the first chamber, the robot configured to remove at substantially atmospheric pressure the second workpiece from the first chamber after processing the first workpiece, the robot configured to reload the first chamber with a fourth workpiece to be processed while the third workpiece is being processed in the second chamber,

the second chamber for processing the third workpiece in a vacuum to completion therein when the power source is applied to the second plasma applicator and switched ON,

exactly one pump adapted to be in fluid communication with the first and second chambers, the pump being configured to perform both process pumping and pump-down pumping of both chambers; and

a computer configured to repeatedly synchronously and alternately control the power source application, the robot movement, the chamber processing, and the pump, the computer configured to control the pump and the robot to effect pump-down and subsequent process pumping of one of the chambers during simultaneous venting, workpiece removal and workpiece reloading of the other of the chambers, such that said pump-down pumping of one of the chambers and said venting of the other of the chambers begin at substantially the same time, and the computer being configured to open the pump to fluid communication with only one of the chambers at a time.

THE REJECTIONS

The prior art relied upon by the Examiner in rejecting the claims on appeal is:

Cox	6,228,773 B1	May 8, 2001
Khan	6,802,933 B2	Oct. 12, 2004 (Dec. 18, 2000)

Claims 12 and 18-25 stand rejected under 35 U.S.C. § 103(a) (2002) as being unpatentable over Cox in view of Khan.[2]

The Examiner found that Cox teaches all the limitations of claim 12 with the exception of a computer configured as claimed. (Ans. 6 and 7). The Examiner found that Khan teaches a computer controller for process control of plural chambers and power. (Ans. 7). The Examiner determined that it would have been obvious to add Khan's computer controller method to Cox's process components for process automation and to optimize the operation of the claimed invention. *Id.* The Examiner additionally contends that in view of the disclosures of Cox and Khan, the operations for controlling plural processing chambers for serial or parallel processing are within the level of ordinary skill in the art. (Ans. 10 and 11).

Appellant contends that Khan does not teach a computer configured to effect pump down and subsequent process pumping in one chamber while another chamber simultaneously undergoes venting, workpiece removal, and workpiece reloading, where the pump down pumping in one chamber begins at substantially the same time as the venting in another chamber. (Br. 12). Appellant argues that Cox teaches away from the operational sequence as Cox's operational sequence is more time efficient than the claimed operational sequence. (Br. 12 and 13, Reply Brief, filed March 10, 2008, hereinafter, "Rep.," 7-10).

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[2] We do not address the other rejections of claims 1, 3-12, and 18-25 on the grounds of 35 U.S.C. § 102(f) and §102(g), obviousness-type double patenting, and obviousness over certain prior art references as these rejections have been withdrawn by the Examiner and/or are moot in view of the cancellation of claims 1 and 3-11. (Ans. 2 and 3).

ISSUE

Based on the contentions of the Examiner and the Appellant, we frame the issue before us on appeals as: Has Appellant shown that the Examiner erred in rejecting the appealed claims as being obvious to one of ordinary skill in the art over the cited prior art of record?

We answer this question in the negative.

FINDINGS OF FACT

The record supports the following findings of fact (FF) by a preponderance of the evidence.

1. Appellant's Specification states:

> The inventors have discovered that, in practice, the ideal "zero overhead" operating condition of the previous system is not always achieved because in some situations, the preparation phase takes slightly longer than the processing phase. For example, a given process, such as a photoresist removal process, may take roughly 15 seconds to complete. If the preparation phase also took 15 seconds to complete, the system would be operating at "zero overhead," and thus the system of Figure 1 could process 240 substrates per hour. In certain situations, however, the system of Figure 1 has been found to have a throughput rate of only 200 substrates per hour for a 15 second process, thus implying that the preparation phase can take slightly longer than the processing step.
> (Spec. [0022]).

2. Appellant's Specification states:

> As illustrated graphically in Figure 3, if the steps carried out in the preparation phase 90 of the first chamber 10 (for example) are not completed when the second chamber 12 finishes its processing phase 100, then the process pump 22

> must idle until the first chamber 10 can be transitioned to the processing phase 100. Similarly, in the system of Figures 1 and 3, the pump-down pump 20 will remain idle for substantial lengths of time during which it is not needed. These idle times represent a substantial facility expense incurred in operating and maintaining the pumps.
> (Spec. [0023]).

3. Appellant's Specification states:

> These idle times can be substantially eliminated by switching the pump down procedure from the preparation phase 90 to the processing phase 102 as shown in Figure 4, thereby providing substantial savings in facility expense as well as allowing for the elimination of a number of costly pumping system components.
> (Spec. [0024]).

4. In Appellant's system where venting, unloading, loading, and pump down take longer than processing, the computer is configured to locate the down time between loading the wafer and pumping down of a chamber. (Exhibit A).
5. In Appellant's depiction of Cox's single pump systems, the computer is configured to locate the down time between processing and venting. (Exhibit A).
6. Cox discloses process systems containing a single vacuum pump to reduce costs. (Col. 2, ll. 2-22, Fig. 15, col. 8, ll. 35-53, col. 13, ll. 14-39).
7. Cox states:

> One need not be concerned about connecting both chambers to a single vacuum pump out of fear of interaction when one chamber is processing a wafer and the other chamber begins to pump down from atmosphere, expecting that the burst of air could potentially travel down the vacuum line to the pump and

> back up to the chamber processing the wafer. The most negative pressure is going to be at the pump head. If the vacuum lines are long enough and big enough in diameter, the pressure will equalize and expand to fill the space. By the time the side that is pumping down reaches the pump, the pressure will be very low. . . . The key to this working is sufficiently long vacuum lines to provide isolation between the two process chambers.
> (Col. 13, ll. 14-32).

8. Cox states:

> In other words if the wait time is zero, then the overhead is near zero and 100% utilization of the processing capacity of the machine is being realized. Achieving near zero wait time is simply a function of doing what is necessary to shorten and equalize the processing times in the adjacent chambers while speeding up the robot to finish his tasks in the same or similar amount of time.
> (Col. 14, ll. 44-50).

9. Cox expressly recognizes that down time occurs as Cox refers to the overhead as being "near zero" throughout the patent, acknowledging that overhead time exists in some applications. (Col. 8, ll. 35-36, col. 9, ll. 42-49, col. 14, ll. 39-50).

10. Cox teaches that his invention has the advantages of elimination of redundant costs and increasing system throughput. (Col. 6, ll. 32-62).

11. Khan states:

> Sequencing recipes determine how substrates move from the loadlocks through the processing and auxiliary chambers of processing system **400**. Sequencing recipes can be associated with individual substrates, groups of substrates or entire cassettes of substrates. Sequencing recipes employ scheduling

> algorithms to optimize substrate throughput, chamber utilization and minimize deadlocks.
> (Col. 28, ll. 1-7).

PRINCIPLES OF LAW

"Section 103 forbids issuance of a patent when 'the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains.'" *KSR Int'l Co. v. Teleflex Inc.*, 127 S. Ct. 1727, 1734 (2007).

ANALYSIS

Appellant has not separately grouped the claims on appeal. Accordingly, we confine our discussion to appealed claim 12 pursuant to 37 C.F.R. § 41.37(c)(1)(vii) (2006).

Appellant's contention that the computer configured as claimed would not have been obvious over Cox in view of Khan is unpersuasive. Appellant argues that in dual chamber processing systems, each chamber undergoes the following steps for operation: (1) load; (2) pump down; (3) process; (4) vent; and (5) unload. (*See* Rep. 8). Appellant's Specification characterizes loading, pump down, venting, and unloading as a "preparation phase," while processing is characterized as a "processing phase." (FF 2). Appellant's Specification states that by switching the pump down procedures from the preparation phase to the processing phase, substantial savings in facility

expense as well as the elimination of pumping system components may be obtained. (FF 3).

We are of the opinion that whether the pump down procedure is characterized as part of a "processing phase" or a "preparation phase," is immaterial, as the timing of the actual tasks that need to be completed in each chamber relative to the other controls the processing sequence.[3] In situations where the processing requirements for a particular semiconductor wafer dictate that venting, unloading, loading, and pump down take longer than processing, any down time present as a result must be distributed between the two chambers. The computer configuration depends on where in the process sequence the down time is located. The computer in Appellant's system is configured to locate the down time between loading the wafer and pumping down of a chamber. (FF 4). In Appellant's depiction of Cox's single pump systems, the computer is configured to locate the down time between processing and venting. (FF 5).

Appellant argues that the presently claimed process system sacrifices temporal efficiency of two pump "zero overhead" systems for two advantages: (1) a reduction in the number of pumps, and (2) process pumping during the entirety of each chamber's processing phase. (Br. 13, Rep. 7; FF 2). However, Cox also teaches these advantages. Specifically, Cox discloses dual chamber processing systems containing a single vacuum

[3] We note that the present claims are directed to a dual chamber processing system, in which the computer configuration is a physical limitation. *See In re Bernhart*, 417 F.2d 1395, 1400 (CCPA 1969) (if a machine is programmed in a certain new and unobvious way, it is physically different from the machine without that program; its memory elements are differently arranged); *In re Lowry*, 32 F.3d 1579, 1583-84 (Fed. Cir. 1994).

pump to reduce costs. (FF 6). In addition, Cox teaches that a single vacuum pump may be used to process a wafer in one chamber while the other chamber begins to pump down. (FF 7; Ans. 12). Thus, Cox teaches processing pump throughout the entirety of each chamber's processing phase, despite Appellant's arguments to the contrary. (Rep. 7, 8, and 10). Accordingly, Cox's processing systems provide both advantages of the presently claimed processing system. Appellant has not provided sufficient evidence that processing systems containing a single vacuum pump with the computer configured as claimed provide any unexpected advantages over Cox's processing systems in view of the teachings of Kahn. Therefore, we agree with the Examiner that the location of the down time in the operational sequence would have been an obvious variation in optimizing the processing system. *See In re Burhans*, 154 F.2d 690, 692 (CCPA 1946) (in the absence of unexpected results, the ordering of process steps is prima facie obvious).

Moreover, although Cox states that simultaneous pumping on each chamber may be accomplished through the use of long vacuum lines, the potential interaction between each of the chambers in a single vacuum pump system during simultaneously pumping would have provided incentive for one of ordinary skill in the art to configure the computer to pump each chamber separately. (*See* FF 7). This would definitively prohibit any unwanted interaction between the two chambers and eliminate the need for long vacuum lines. *KSR*, 127 S. Ct. at 1740 ("When a work is available in one field of endeavor, design incentives and other market forces can prompt variations of it, either in the same field or a different one. If a person of ordinary skill can implement a predictable variation, §103 likely bars its patentability"). Thus, we agree with the Examiner that Cox in view of Khan

suggests that the sequence to which the computer is configured would have been within the knowledge of one of ordinary skill in the art in optimizing the processing system for processing a particular wafer. (Ans. 7 and 8).

Appellant's argument that Kahn provides generalized teachings that do not suggest the specific computer configuration presently claimed is unpersuasive. Appellant cites our recent decision in *Ex Parte Beresford*, No. 2007-2322, 2008 WL 111202 (BPAI, Jan. 9, 2008) for support. However, in that case, the Examiner had provided no rationale to support the rejection other than a quotation from the reference. *Beresford*, 2008 WL 111202, at *4. Here, in addition to the Examiner's citation to specific passages in Khan, the Examiner also provides the rationale of process automation, equipment economization, and operation optimization. (Ans. 7). Moreover, the Examiner's rationale is supported in the references. Cox states that the overhead and processing times may be adjusted to reduce wait times. (FF 8). In addition to the passages cited by the Examiner, Khan states that processing sequences are "associated with individual substrates, groups of substrates or entire cassettes of substrates." (FF 11). Khan also states that sequences "employ scheduling algorithms to optimize substrate throughput, chamber utilization and minimize deadlocks." (FF 11). Therefore, both references support the Examiner's finding that processing sequences may be varied to optimize the processing system. Appellant has not provided sufficient evidence to rebut the Examiner's finding that the optimization of the processing system for a particular application would have included adjusting the computer configuration to fall within the configuration as presently claimed.

Appellant further contends that optimization to the claimed computer configuration would not have been obvious because Cox did not recognize all the characteristics of the actual operation sequences taught in the patent, namely that Cox's "zero overhead" systems actually experience down time. (*See* Rep. 8). To that end, Appellant's Specification states that the throughput rate "in certain situations" may be less than theoretically possible, "implying that the preparation phase can take slightly longer than the processing step." (FF 1). As a result, Appellant argues that Cox teaches away from the presently claimed sequence, because one would sacrifice the time efficiency of Cox's "zero overhead" system by configuring the computer as presently claimed. (Rep. 8 and 9). We are not persuaded by Appellant's argument for several reasons.

First, Appellant's acknowledgment that down time in Cox's systems does not occur in all situations indicates that the processing conditions depend on the specific application and are within the skill of one of ordinary skill in the art. Second, Appellant's statement that the preparation phase is longer than the processing phase is inconsistent with the conditions Cox discloses in order to achieve "zero overhead." Cox states:

> To reach peak optimization, the robotic transfer overhead plus pump and vent overhead time should be less than the total active wafer processing time…*In this mode*, a near 100% equipment utilization condition for active process is achieved versus the typical situation of 30% utilization or even less for short process times. (Col. 8, ll. 54-59). (Emphasis added).

From this passage it is clear that for Cox's "zero overhead" process, the process time must be greater than the preparation time. Appellant's depiction of Cox fails to employ Cox's "zero overhead" mode, because the

preparation time is longer than the processing time. Third, Cox states that "zero overhead" is one mode of the invention. Cox expressly recognizes that down time occurs as Cox refers to the overhead as being "near zero" throughout the patent, acknowledging that overhead time exists in some applications. (FF 9). Thus, Cox discloses other modes besides "zero overhead" in processing applications according to his invention. In such modes, the other advantages of the process system such as elimination of redundant costs and increasing system throughput taught by Cox would still be realized. (FF 10). Therefore, we are not persuaded that Cox teaches away from the presently claimed process system configuration.

CONCLUSION

In light of the above discussion, Appellant has failed to demonstrate that the Examiner erred in rejecting claims 12 and 18-25 under 35 U.S.C. § 103(a) as being unpatentable over Cox in view of Khan.

ORDER

The Examiner's decision rejecting claims 12 and 18-25 is affirmed.

No time period for taking any subsequent action in connection with this appeal may be extended under 37 CFR § 1.136(a)(1)(iv).

AFFIRMED

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KNOBBE, MARTENS, OLSEN & BEAR LLP
2040 MAIN STREET
FOURTEENTH FLOOR
IRVINE, CA 92614